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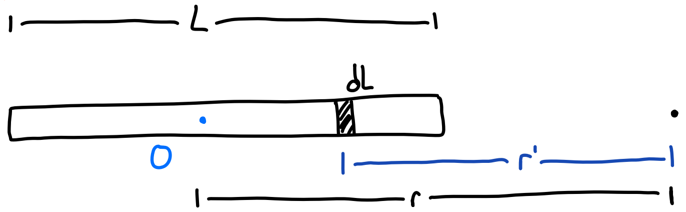
Dr. Middleton PHYS 132
2-2 HW

Ch. 26 Probs. 40
Ch. 28 CQ's. 4, Probs. 2 & 4

Ch. 26 P. 40

26.P.40



$\lambda = \frac{Q}{L}$

$L\lambda = Q$

$E = \frac{K\Delta Q}{\Delta r}$

a.)

$$\int_{-L/2}^{L/2} \frac{K\Delta Q}{(r-r')^2} = \int_{-L/2}^{L/2} \frac{K\lambda}{(r-r')^2}\,dr = \int_{-L/2}^{L/2} \frac{KQ}{L(r-r')^2}\,dr$$

$u = r - r'$
$du = -r'\,dr$

$$\int_{-L/2}^{L/2} \frac{KQ}{L(r-r')^2}\,dr = \frac{KQ}{L}\int_{-L/2}^{L/2} \frac{1}{(r-r')^2}\,dr = \frac{KQ}{L}\int_{-L/2}^{L/2} (r-r')^{-2}\,dr$$

$$\frac{KQ}{L}\int_{-L/2}^{L/2} (u)^{-2} r'\,du = \frac{KQ}{L}\left[\frac{-r'}{(r-r')}\Big|_{-L/2}^{L/2} \right] = KQ\left(\frac{1}{r^2 - L^2/4}\right)$$

a.) $\frac{KQ}{r^2 - L^2/4}$

$L/2 - (-L/2) = \frac{L}{L} = 1$ L's cancel out $\frac{KQ}{r^2 - L^2/4}$

b.) If r is growing much bigger in comparison to L, we can treat L as if it were approaching 0.

$$\lim_{L \to 0} \frac{KQ}{r^2 - L^2/4} = \frac{KQ}{r^2 - 0/4} = \frac{KQ}{r^2}$$

b.) $\frac{KQ}{r^2}$

C.) $\frac{KQ}{r^2 - L^2/4}$

$r = 0.03\,m$
$L = 0.05\,m$
$Q = 3.0 \times 10^{-9}\,C$

$$\frac{9.0 \times 10^{+9} \frac{Nm^2}{C^2}(3.0 \times 10^{-9} C)}{(0.03m)^2 - (0.05m)^2/4} = 9.8 \times 10^4\,N/C$$

C.) $9.8 \times 10^4\,N/C$

a.) $\frac{KQ}{r^2 - L^2/4}$ b.) $\frac{KQ}{r^2}$ C.) $9.8 \times 10^4\,N/C$

Ch. 28 CQ: 4 Probs 2 & 4

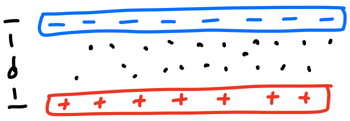
Conceptual
28.C.4

a.) The change in potential energy of path (1→3) and path (1→2) are equal because it is a conservative force. It is also the same height for both paths.

b.) Same speeds since change in potential energy is equal.

Problems

28.P.2



$\vec{E} = 20{,}000\ N/C$
$d = 0.001\,m$

$W = KE$

$\Delta U = -W$
$\Delta U = qE\Delta S$
$W = \frac{1}{2}mv^2$

$\vec{E} = \frac{\eta}{\epsilon_0}$ $\epsilon_0 \vec{E} = \eta$
$\eta = 1.77\times10^{-7}\ C/m^2$

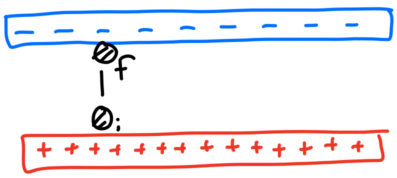
$q = -1.602\times10^{-19}C$
$E = 20{,}000\ N/C$
$\Delta S = 0.001\,m$

$q = -1.60\times10^{-19}C$
$E = 20{,}000\ N/C$
$\Delta S = 0.001\,m$
$m_e = 9.11\times10^{-31}\,kg$

$-QE\Delta S = -\frac{1}{2}mv^2$
$2QE\Delta S = mv^2$
$\frac{2QE\Delta S}{m_e} = v^2$
$V = \sqrt{\frac{2QE\Delta S}{m_e}}$

$V = 2.65\times10^{6}\ m/S$

28.P.4



$V_i = 0\ m/s$
$V_f = 50{,}000\ m/s$

$KE = \frac{1}{2}mv^2$

$m = 4m$

Proton : $\frac{1}{2}m_pV_p^2$ Helium : $\frac{1}{2}m_HV_H^2$
uniform $\vec{E}$ ∴ $KE_p = KE_H$

$\frac{1}{2}m_pV_p^2 = \frac{1}{2}m_HV_H^2$
$m_pV_p^2 = m_HV_H^2$
$V_H^2 = \frac{m_pV_p^2}{m_H}$
$V_H = \sqrt{\frac{m_pV_p^2}{m_H}}$

$V_H = \sqrt{\frac{m_pV_p^2}{4m_H}}$

$V_p = 50{,}000\ m/s$
$m_p = 1.67\times10^{-27}\,kg$
$m_H = 4(1.67\times10^{-27}\,kg)$

$V_H = 25{,}000\ m/S$